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REPRODUCTIVE PERFORMANCE, FEED INTAKE AND EFFICIENCY OF INDIGENOUS AND CROSSBRED TURKEYS

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ABSTRACT

This study assessed the reproductive performance of indigenous and crossbred parent stocks and the influence of sire genotype on the growth and efficiency of feed utilization by their progenies. A total of 300 poults, 150 for each genotype were generated from two crosses (Nicholas white x Indigenous and Indigenous x Indigenous turkeys). Data were collected on the reproductive performance of the parents while body weight and feed intake from day old to the 20th week of age were also collected from the progenies generated. The experiment was a complete randomized design with data generated subjected to two way analysis of variance using SAS. The result of the study showed that sire genotype had significant effect ($p<0.05$) on semen colour and semen volume while semen pH, motility, morphology and live dead ratio were not significantly affected. Crossbred tom had higher semen volume (0.39 ml) compared to 0.18 ml recorded in indigenous turkey. Genotype had no significant effect ($p>0.05$) on all female reproductive traits such as fertility, hatchability, dead in-germ, weak in-shell and dead in-shell. However, the indigenous turkey had higher fertility percentage (85%) while 80% hatchability was observed in crossbred turkey. Crossbred turkey significantly ($p<0.05$) had higher body weight (3330g) at 20 week of age compared to the indigenous turkey (2869g). Sexual dimorphism in favour of the male turkey was also observed throughout the period of the experiment. Although the crossbred turkey consumed more feed, the efficiency of feed utilization was better in the indigenous turkey. This findings suggested that the indigenous turkeys can be successfully improved with the introgression of exotic genetic material while crossbred turkeys can be further selected for improved productive and adaptive traits.

Keywords: reproductive traits, feed efficiency, productivity, turkey genotype.

INTRODUCTION

The domestic turkey (*Meleagris gallopavo*) which originated from North America, is raised throughout the world but its wild progenitor descends from Eastern and Southwestern United States and central/ northern Mexico (Thornton *et al*., 2012). It is an important poultry species which begins to gain popularity in Nigeria recently, with its production being on a very low scale until

last decade (Hogan, 2008). Turkey is reared majorly for meat and it is a very good source of animal protein which is able to bridge the problem of protein. In Nigeria, calorie deficiency is a situation where an average Nigerian per capita intake of animal protein stands at a meager 9g per day (Boland *et al*., 2013) and which is far below the FAO recommended value of 35g (Oyawoye, 1999).

Increase in demand for turkey meat steps up its production globally (Case *et al*., 2010). According to Maikasuwa *et al*. (2014), turkey production can now be found almost in all parts of the country in Nigeria but at a very low scale and most of which are indigenous breeds with only few exotic breeds (such as Nicholas white, Kelly and British United) and their crosses (Maikasuwa *et al*., 2014).
Nigeria indigenous turkeys are generally hardy, naturally tolerant to most of the diseases of turkey in temperate region, can survive on low nutrient feed resources and best adapted to prevailing tropical climatic conditions. These birds are nondescript with multi-coloured plumage and sometimes appearing as pure black or white. These indigenous types are, however, the least studied of the domestic fowls and very little effort has been directed at increasing their productivity.

Three genotypes are distinctly identified including white, black and lavender. The toms and hens are always kept together and mating is mainly by natural system hence the fertility and hatchability are usually low (Ngu *et al.,* 2014). More so, hatching is by natural method in which the hen sits on her eggs for a duration of 28 days. As reported by Ngu *et al.* (2014), in most cases, the hens do not hatch all the eggs. Nigeria indigenous turkey, just like other birds, lay their eggs in clutches. Average of 2-3 clutches per year with an average clutch size of 10-15 eggs, average clutching interval of 2-3 months and an estimated hatchability of 50% were reported (Ngu *et al*., 2014). Hatchability is, therefore, one of the critical factors limiting the number of indigenous turkeys raised in Nigeria.

The exotic turkeys are generally improved breeds which have been selected through decades for economic traits such as higher body weight, excellent reproductive performance and early maturity (Ilori *et al.,* 2010; 2012). However, their potentials cannot be achieved under low input and harsh environment such as in the tropics. Improving the production of exotic turkeys (such as Nicholas white, Kelly and British united turkeys) has been the central objective of several research studies on turkey production in the past. The results of which show improved percent breast meat, feed efficiency, fecundity, livability improved average daily intake and steady increase in feed conversion ratio (Roberson *et al.,* 2004). However, little research efforts have been directed towards improving the indigenous turkeys despite their numerous genetic potentials.

Improvement in performance of indigenous stock over the time can arise through improving management and feeding conditions and genetic improvement by use of genetically superior animals (Yakubu *et al*., 2012). Earlier report by Adebambo *et al.* (2006) suggested that the controlled introduction of new and improved genetic materials into indigenous breeds of bird is expected to speed up genetic progress through the exploitation of hybrid vigour. Thus, the productivity of indigenous turkeys can be improved by crossbreeding exotic toms, having superior genetic make-up with indigenous hens.

Crossbreeding between indigenous stock and exotic turkey, would take advantage of productive merits which have already been accumulated through selection in the exotic turkeys as well as merits for hardiness which have been endowed in indigenous turkeys through decades of natural selection (Adebambo *et al.*, 2006). The need to improve indigenous turkey using exotic genetic make-up would only be justified if the crossbred shows superior performance on economic traits including feed efficiency and reproductive performance. This current study, therefore, aimed to evaluate genetic variation in feed efficiency and reproductive performance of indigenous and crossbred turkeys in Nigeria.

MATERIALS AND METHODS

Study area: This study was carried out at the Turkey Breeding unit of the Teaching and Research Farm of the College of Animal Science and Livestock Production (COLANIM), Federal University of Agriculture, Alabata road, Abeokuta, Ogun State, Nigeria. The farm location is 76 meter above sea level and falls within latitude $7^{0}15^{1}$N and longitude $3^{0}25^{1}$E. It is in Odeda Local Government area of Ogun State and lies in the derived savannah vegetation zone of south western part of Nigeria. It experiences approximately eight months of rainfall (usually from March to October), with a mean annual precipitation of 1,037mm. The monthly ambient temperature ranges from 28^{0}C in December to 36^{0}C in February with a mean relative humidity of 82% as described in our previous studies (Ilori *et al*., 2010; Google Earth, 2018).

The experimental birds

Two genotypes of turkey (indigenous and crossbred) including sexually matured toms comprising ten crossbred (Nicholas white ×Indigenous) and ten indigenous breed and one hundred point of lays comprising fifty each of indigenous hens and crossbred hens were used for this experiment.. The birds were selected from the indigenous and crossbred stock being maintained on the farm at the time of the conduct of this experiment. The initial exotic stock (Nicholas white) were purchased from Obasanjo Farm Holdings, Ota Ogun state, Nigeria. A mating ratio of 1:5 (male: female) was used to generate progenies from the parent stock.

Management of experimental birds

The birds were raised under intensive system of management. The toms and hens were housed separately on deep litter. Feed and water were provided *ad libitum*. They were placed initially on grower mash and provided with breeder mash after they attained 10% egg production. Multivitamins were administered to the birds; on the first day as they arrived on the farm to serve as anti-stress and stabilize them and subsequently a day before and after vaccination. All prescribed vaccination and drugs were strictly followed. Adequate biosecurity measures such daily washing of the drinkers, disinfection of pen surroundings, use of foot dip and periodic changing of litters, were carried out and upheld to prevent occurrence of diseases. The birds were wing tagged for proper identification. The two genotypes were reared in different pens but under the same management system as described by Oluyemi and Roberts (2000).

Mating procedures, egg collection and hatching

Artificial insemination technique as described by Lake (1962) was used due to large differences in body weight between toms and hens. The indigenous poults were generated by crossing indigenous toms with indig-

enous hens while the crossbred poults were generated by crossing crossbred toms with crossbred hens. Eggs from the two genetic groups were collected twice daily, identified appropriately with label, sorted and set in the incubator on weekly basis for hatching.

Management of poults

Poults generated from each genotype were properly identified and wing-tagged. The poults were brooded in deep litter pens according to their genetic groups. They were all subjected to the same management practices throughout the experimental period. They were being fed with commercial feed and clean water *ad libitum*. Starter diets containing 28% crude protein (CP), grower mash of 24% CP and finisher mash of 20% CP were provided for the birds from 0-6 weeks, 7-16 weeks and 17-20 weeks of age, respectively. The birds were vaccinated against Mareks, Newcastle and fowl pox diseases while prophylactic antibiotics and anticoccidial drugs were also administered.

Data Collection

The reproductive parameters taken include; semen colour which was evaluated visually and scored using a three-point scale described by Hafez (1987), semen volume was measured in millimeters with the use of a collection tube. Semen motility was determined by subjective measurement based on the judgment of individuals making the determination. The average motility for each genotype of turkey was then calculated and expressed as the percentage of cells that are motile under their own power (Hafez, 1987). The sperm concentration was measured using direct cell count method with the haemocytometer. The concentration was then estimated using the formula C = 50,000 x N x D where C is the concentration of semen per volume (ml), N is the number of spermatozoa counted and D is the dilution rate (San Diego *et al*., 2017). Semen pH was determined with the aid of a calibrated pH meter. Other reproductive parameters taken include; total number of eggs set per sire/dam genotype, total number of fertile eggs per sire/dam genotype, total number of hatched eggs per sire/dam genotype, percentage fertility per sire/dam and percentage hatchability per sire/dam.

Body weights were taken weekly on one hundred and fifty each poults of the two genetic groups generated from the matings from day old to 20 weeks of age. Feed intakes were recorded on daily basis while feed efficiency was computed for the two genetic groups throughout the experiment. Mortality records were kept for the two genotypes.

Statistical analyses

Data obtained were analyzed using General Linear Model of SAS (1999). The model used was:

$Y_{ijk} = \mu + G_i + S_j + (GS)_{ij} + eijk.$

Where

Y_{ijk} = The parameter of interest, μ = overall mean for parameter of interest, G_i = effect of the i^{th} genotype (i= 1, 2), S_j = effect of j^{th} sex (J = male, female), $(GS)_{ij}$ = effect of the interaction of the genotype and sex, e_{ijk} = random residual error.

Means which were significant were separated using New Duncan's Multiple Range Test (Duncan, 2005) at 5% level of probability.

RESULTS

Semen Examination

The summary of the analyses of variance indicated that the genotype had significant effect on semen volume and colour ($p<0.05$). The crossbred turkeys had a higher

semen volume (0.39±0.01) than the indigenous turkeys (0.18±0.02) (Table 1). Visual examination of the semen colour reveals that the semen of the indigenous toms was milky white while that of crossbred toms was creamy white. No significant difference were observed for semen concentration, semen pH, semen motility, sperm morphology and percentage livability (P>0.05) between the two genotypes. The semen pH for the two genotypes was slightly alkaline (7.04±0.03 and 7.04±0.18 for crossbred and indigenous toms, respectively). Furthermore, values on semen motility indicate that the crossbred turkey had a higher value for percent progressive motility of 65.33±2.18% while the indigenous turkey had 62.42±1.82%. Likewise, the results on sperm morphology showed higher mean value for normal sperms (84.71±1.31) in crossbred and higher mean value of abnormal sperms (17.62±2.16) in indigenous turkeys. However, the percentage livability of the sperm showed the highest value for the indigenous toms (84.22 ±1.41) compared to 82.84 ±1.14 in crossbred.

Reproductive traits

For all the reproductive traits examined (fertility, hatchability, dead-in-germ, weak-in-shell and dead-in-shell), sire genotype did not have significant effect as shown in Table 2. The least square means for fertility indicated a higher fertility (85%) for the indigenous turkeys compared to that of the crossbred turkeys (82%). However, with respect to hatchability, the crossbred turkey had the higher value (80.00±0.08) than the indigenous (76.00±0.03). Dead-in-germ in crossbred was slightly higher in crossbred (7%) than in indigenous turkeys (6%). Also, values obtained with respect to weak in-shell and dead in-shell in both genotypes were not significantly (p<0.05) different.

Body weight: The analyses of variance for body weight (BW) show that body weight was not affected by genotype (P>0.05) except at 20 weeks of age as shown in Table 3. However, the crossbred shows consistent higher mean values for body weight throughout the weeks of the experiment. Conversely, sex significantly affected (p<0.05) the body weight of the poults except at 2 weeks of age. The male turkeys consistently showed higher least square mean values in all the weeks of the experiment for both genotypes.

Table 1: Least squares means of semen quality and quantity traits as affected by turkey genotype

Genotype	Colour	pH	Volume (ml)	Total motile (%)	Cynic moving sperm (%)	Normal sperm (%)
Indigenous	Milky white	7.04±0.00[a]	0.18±0.02[b]	62.42±1.82[a]	10.51 ± 1.4[a]	82.38 ±2.16[a]
Crossbred	Creamy white	7.04 ±0.18[a]	0.39 ±0.01[a]	65.33±2.18[a]	10.38±1.14[a]	84.71 ±1.31[a]

Table 1 cont'd: Least squares means of semen quality and quantity traits as affected by turkey genotype

Genotype	Abnormal sperm (%)	Live (%)	Dead (%)	Per 10ml spermatozoa	Slide moving sperm (%)
Indigenous	17.62 ±2.16[a]	84.22±1.41[a]	15.78±3.07[a]	221.63×10^{8}±10.02[a]	89.49± 1.41[a]
Crossbred	15.29 ±1.51[a]	82.84±1.14[a]	17.16±2.10[a]	233.50×10^{8}±9.66[a]	89.63 ±1.14[a]

Means in the same column with different superscripts are significantly different ($p<0.05$).

Table 2: Least squares means of reproductive traits in indigenous and crossbred turkeys

Genotype	N	Fertility(%)	Hatchability(%)	Dead-in germ(%)	Weak-in shell	Dead-in shell (%)
Indigenous	45	85.00±0.04[a]	76.00±0.03[a]	6.00±0.03[a]	9.00±0.03[a]	2.00±0.01[a]
Crossbred	45	82.00±0.08[a]	80.00±0.08[a]	7.00±0.03[a]	9.00±0.01[a]	2.00±0.02[a]

[a]*Mean in the same column with the same superscripts are not significantly different (P>0.05)*
N= Number of observations

Table 3: Least squares means of body weight (g) as affected by genotype and sex in turkey

Age in weeks	Genotype		Sex	
	Indigenous	Crossbred	Male	Female
0	44.27±0.62[a]	44.32±0.58[a]		
2	85.68±15.33[a]	94.51±2.33[a]	96.41±15.25[a]	71.68±1.96[a]
4	299.78±7.28[a]	338.46±9.96[a]	333.23±8.87[a]	297.83±7.99[b]
8	991.54±21.69[a]	1007.13±31.96[a]	1060.58±24.62[a]	904.64±20.69[b]
12	1743.00±38.50[a]	1840.42±36.91[a]	1844.97±35.91[a]	1591.33±29.47[b]
16	2302.56±45.78[a]	2479.91±43.42[a]	2487.47±40.77[a]	2223.81±47.57[b]
20	2869.68±46.08[b]	3330.79±34.01[a]	3155.57±44.25[a]	2907.86±60.81[b]

within variable grouping, means in the same row with different superscripts are significantly different ($p<0.05$)

Feed intake and feed efficiency

The analyses of variance result show that genotype had significant effect ($p<0.05$) on feed intake in all the weeks except at 2 weeks of age (Table 4). The feed intake increases with increase in age in the two genotypes with the crossbred having the higher feed intake throughout the experiment. The average feed intakes at week two were 10.73±1.05g for Nigerian indigenous turkey and 14.13±2.02g for crossbred turkey. At week twenty, the Nigerian indigenous turkey had an average feed intake value of 225.66±14.26g while the crossbred turkey had 343.99±40.64g as an average feed intake.

The feed efficiency (FE) showed significant effect ($p<0.05$) on turkey genotype at 2, 4 and 12 weeks of age but at 8, 16 and 20 weeks of age, there was no significant different ($p>0.05$) in feed efficiency between the two genotypes (Table 5). The feed efficiency decreased with increase in age with the indigenous turkey having the higher efficiency of feed utilization in all the weeks of the experiment except at 20 weeks of age. The least squares mean values of 0.43±0.05g and 0.57±0.06g of feed efficiency were recorded for crossbred and indigenous genotype at week 2 where as at week 20, the same value (0.11±0.01g) was obtained for both genotypes.

Table 4: The least squares means for the effect of genotype on feed intake (g/day) in turkey

Age in weeks	Genotype	
	Indigenous	**Crossbred**
2	10.73±1.05[a]	14.13±2.02[a]
4	31.93±2.78[b]	65.20±10.77[a]
8	87.39±6.73[b]	136.53±34.82[a]
12	131.83±16.79[b]	212.02±28.31[a]
16	190.03±15.03[b]	281.40±40.02[a]
20	225.66±14.26[b]	343.99±40.64[a]

[ab]Mean in the same row with the same superscripts are not significantly different (P>0.05)

Table 5: Least squares means and standard errors of mean for the effect of genotype on feed efficiency in turkey

	Genotypes	
Age in weeks	Indigenous	Crossbred
2	0.57±0.06[a]	0.43±0.05[b]
4	0.50±0.05[a]	0.26±0.05[b]
8	0.33±0.03[b]	0.27±0.07[b]
12	0.21±0.03[a]	0.13±0.02[b]
16	0.12±0.01[a]	0.10±0.01[a]
20	0.11±0.01[a]	0.11±0.01[a]

[ab]Means in the same row with the different superscripts are significantly different (p<0.05)

DISCUSSION

The difference in semen volume between the crossbred and indigenous turkeys could be attributed to the effect of long term selection of the exotic parent for high growth and reproductive efficiency genes, which the crossbred inherited through crossbreeding (Nestor *et al.,* 2000). The semen concentration did not show any significant difference. The result on semen concentration between the two genotypes agreed with the report of Noran *et al.* (1990) that no significant difference was observed in semen concentration for indigenous Katjang and crossbred bucks. This is an indication of a better adaptive ability of the crossbred turkeys to

the humid tropical environments as evidenced in their ability to compete favourably with the indigenous turkeys. The semen pH values for both genotypes did not differ significantly but was consistent with pH reported for poultry semen (Etches, 1996; Peters, 2000). Although, motility, morphology and livability did not show any significant differences between the two genotypes but the crossbred turkeys maintained consistent better positive values across the parameters considered. The most obvious evaluation of semen is colour. The results of semen colour as observed in this study revealed that the further the deviation from creamy colour of the semen, the more likely the presence of contaminations. This conformed to the findings of Etches (1996). The relationship between semen volume, sperm motility, sperm concentration, percent motile sperm, pH and colour are very important since they determine the fertility potential of the semen to a large extent (Etches, 1996).

Although, genotype did not have significant effect on any reproductive traits, the indigenous turkey had a higher value for percentage fertility probably due to its fitness to the humid environment as compared to the crossbred. However, the reverse was the case with respect to hatchability, where the crossbred turkey had a higher mean value (80.00±0.08) than the indigenous (76.00±0.03). This may be attributed to several factors including physical, environmental or genetic factor (Fairchild, 2000). This result did not agree with the report of Christensen *et al.* (1996) that sire genotype had significant effect on fertility and hatchability in turkeys. Sexton and Randen (1988) also showed that sire exercises an appreciable influence on hatchability though hatchability may not entirely be a function of fertility possibly because of some intrinsic factors associated with the egg. However, it must be emphasized that fertility and hatchability are the most important determinants in the production of poults and they influence, to a large extent, the profitability of the turkey enterprise.

Furthermore, no significant difference was observed in body weight between crossbred and indigenous turkeys except at 20 weeks. However, the crossbred turkey had higher mean values in body weight (from 44.32±0.58g at day old to 3330.79±34.01g at week 20) in all the weeks of the experiment and this suggested that crossbred turkey had a better growth potential than its indigenous counterpart. This conformed with the findings of Ilori *et al.* (2010) that exotic turkey had superior body weight than the crossbred and the later than the indigenous turkey. This was attributed to the fact that the crossbred utilized the advantage of higher growth rate derived from exotic parent to achieve improved body weight. This further proves that the crossbred is able to transmit the gene for faster growth to its progeny. It can be said that these acquired attributes of the crossbreds could make them to be further screened as possible candidates for tropical turkey broiler breed development (Ilori *et al.,* 2010; 2011). The indigenous turkey, on the other hand, showed lower growth rate which suggested that they have not been artificially selected for body weight. Indigenous turkeys have gone through more of natural selection for adaptation and survival to the tropical climate rather than artificial selection for productivity (Ibe, 1998, Ilori *et al*., 2010). The higher growth rate exhibited by males over females of both indigenous and crossbred genotypes used in this study agreed with the findings earlier documented (Akinokun, 1990; Burke, 1994; Hancock *et al.,* 1995 and

Deeb and Cahaner, 2001, Ilori *et al*., 2010). The above authors opined that males consistently had higher mean values than females and this was attributed to the differences in hormonal profile, aggressiveness and dominance of the males when feeding and especially when both sexes are reared together (Ibe and Nwosu, 1999).

The results on feed intake and feed efficiency is consistent with our earlier report (Ilori *et al.,* 2010) that the crossbreds consumed more feed on the average than exotic and local turkeys. The crossbred consumes more feed but with lower feed efficiency in all the weeks of the experiment. This may be due to the fact that the crossbreds combined the genetic make-up of both the indigenous and the exotic turkeys in terms of feed intake. However, the lower mean values for feed efficiency implies that the higher the feed intake needed to achieve a proportional increase in body weight, the lower the feed efficiency obtained and when feed efficiency is low, the quantity of feed to achieve a kilogram body weight is high (Ilori *et al.,* 2010). However, the indigenous turkeys had lower feed intake but higher feed efficiency meaning that they were able to utilize the minimal feed consumed efficiently to achieve a proportionate increase in body weight.

CONCLUSION

Differences in reproductive parameters, body weight, feed intake and feed efficiency observed between the two genotypes could be attributed to differences in their genetic makeup. The crossbred turkey performed better than indigenous turkey in terms of reproduction and body weight while the indigenous turkey showed superiority in feed intake and efficiency. This findings suggested that the indigenous turkeys can be successfully improved by introgression of exotic genetic make-up while crossbred turkeys obtained can be further screened and improved to a stage where it will have superior quality in most productive and adaptive traits than their indigenous and exotic parents.

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